

# The Effect of Age and Gender on the Level of Daily Physical Activity of Children with Autism Spectrum Disorder: A Case Study in Iran

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## Abstract

**Background and aim:** Evaluating and monitoring the level of Daily Physical Activity (DPA) and the factors affecting it are very important for children with Autism Spectrum Disorder (ASD). In this regard, the aim of this study is to investigate the effect of age and gender on the level of physical activity of children with ASD.

**Materials and methods:** The present study was a descriptive cross-sectional type, in which 62 children with autism, with an age range of 7-14 years, including 45 boys and 17 girls, were randomly selected by available sampling method. DPA was evaluated for 4 days by accelerometer. Also, the severity of the disorder related to autism was evaluated in the four fields of communicative verbal skill, social skill level, cognitive sensory awareness level, and health and behavior using the autism treatment evaluation checklist. Finally, the raw data from the study was analyzed by SPSS-Ver.22 software.

**Results:** The findings of the present study showed that girls have a significantly lower level of DPA than boys and as a result are less active than them. According to the results, with increasing age, the DPA of children with ASD decrease significantly. The level of DPA of the participants showed a negative and significant relationship with the severity of their disorder in the field of cognitive sensory awareness, as well as the level of their intense DPA with the overall score of the severity of their disorder. The variables of age, gender, and the level of cognitive and sensory awareness of the participants were the most important factors predicting the DPA of children with ASD.

**Conclusion:** According to the results obtained from the present study, it can be concluded that children with high functioning autism suffer from inactivity, and their sedentary activities increase with age. According to the results of this study, it is suggested that effective physical activity interventions, especially periods of intense physical activity, should be designed. Then suitable opportunities for children with ASD to participate in physical activities, especially in girls, to prevent inactivity and reduce their physical activity in older ages should be provided. In addition, it is recommended to use physical activity programs, especially with high intensity, to reduce the severity of the disorder in children with ASD.

**Keywords:** Autism spectrum disorder • Daily physical activity • Age • Gender • Iran

## Introduction

Autism Spectrum Disorder (ASD) is a developmental disorder characterized by deficits in communication and social interactions. People with ASD are unable to perform social skills and roles, and the symptoms of this disorder appear before three years old [1]. Children with ASD have problems in verbal and non-verbal communication, social interactions and have stereotyped and

repetitive behaviors [2]. Impaired social skills are the most well-known and enduring feature of ASD [3]. Many autistic children do not show any emotional or social reciprocity [4]. Therefore, defects in social skills and interactions not only hinder the growth of these children, but also cause isolation of these children from friends, peers and adults [5].

The American psychiatric association identifies multiple non-verbal behavior disorders, the inability to communicate with peers in a way

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that is appropriate for the level of development, the failure to automatically share one's interests with others, and the lack of social interaction of autistic people as symptoms of social disorder [6].

One of the most important goals of autistic children's education is to create social adaptation, establish useful and effective communication with others, and accept social responsibility and self-help skills [7]. Researchers have proposed various therapeutic interventions in children with ASD, the most prominent techniques of single subject designs are video models, social stories, law cards, vision interventions, applied behavior analysis, and social skills exercises, music therapy, and the method of exposure and response inhibition [9-10].

One of the promising treatment methods that have attracted the attention of many specialists in the last three decades is interventions related to movement and physical activity [11-14]. Various studies have investigated the effects of different movement activities on autistic children. These physical movement activities include cycling and weight lifting, skating, swimming and water aerobics to reduce stereotyped behaviors and violent behaviors [15-19]. Also, the influence of physical activities on autistic children to improve executive functions such as working memory and metacognition, weight loss and fitness, movement behaviors and social skills, improving academic performance and self-control has also been investigated by researchers [20,21].

Also, participating in movement and physical activities provides an important opportunity to increase wider social connections, wider social solidarity and create stronger social and friendly networks [22]. In addition, according to the results of past studies, recreational activities have a positive effect on improving the skills and social interactions of autistic children [23].

Various studies have been conducted in the field of physical activity of these children, but in Iran there are very few results about the status and pattern of physical activity of children. It is noteworthy that in order to determine the physical activity status of children with autism, it is necessary to identify the determining factors related to it [24].

One of the factors that researchers pay attention to in examining physical and health behaviors is people's age. It seems that as the age of autistic children increases, they are more exposed to inactivity due to facing limitations and developmental disorders. It has been shown that with age, autistic children are more exposed to obesity and its risks, which can be caused by decrease in physical activities in childhood and continue until adulthood. Therefore, it is very important to evaluate the PDA of these children and how it changes along with the increase in predicting their condition and preventing their inactivity in adulthood [25,26]. Despite the relationship between PDA and environmental factors such as family support and access to facilities, according to the autonomy model, factors related to the disorder, its type and severity can be a determining factor in the level of individual activity [27].

Considering the importance of the above issues and considering the high prevalence of ASD it is necessary to evaluate health behaviors, especially PDA in autistic children, which is an important factor in improving their quality of life, and to identify its relationship with the deficits and symptoms of this disorder. In addition, identifying the PDA pattern of these children and its related factors can help to

identify and remove possible obstacles for these children to participate in physical programs and activities. The main aim of the present study is to examine the PDA of 7-14 years old autistic children and then evaluate the relationship between the PDA level of these children, their age and the severity of their disorder [28].

## Material and Methods

### Sampling

The current study is a cross-sectional and retrospective study, and the statistical population of this study was all students with autism with high performance in autism elementary schools in one of the cities of Iran (160 people). The age range of the investigated students is between 7-14 years old who were studying in the 2020-2021 academic year. The participants of the present study were selected from among 4 autism schools, using available sampling method. A questionnaire was completed by the families of selected autistic children to identify the children who had the necessary conditions to participate in the research. These conditions were: not having mental retardation, having the ability to walk independently without an aid and no history of orthopedic disorders in the limbs and spine [29]. After identifying the desired children among the volunteers participating in the research, 90 peoples with the age range of 7 to 14 years were selected, and finally 70 of them formed the current research participants.

### Measurement of physical activity level

An accelerometer weighing 27 grams and with dimension equal to 1.8 cm × 3.7 cm × 8.3 cm was used to measure the PDA level of the participants, and its validity and reliability were confirmed according to the standard method [30]. This device is sensitive to the smallest movements of the person and its output data shows the amount and intensity of the person's movements. In addition, this device is sensitive to the smallest movements of the person and the output data of the device shows the amount and intensity of the person's movements. In addition, the number of individual steps is also recorded by the device [31]. The data related to the person's activities were recorded by the accelerometers and at the end of the data collection, the accelerometers were connected to a computer and the collected data was transferred to it. For a reliable and valid estimate of PDA in children and adolescents, four days (including three days in the middle of the week and one day on the weekend) and daily at least 8 hours of evaluation and monitoring were reported [32].

From the numbers obtained from the children's activities that were collected at one minute intervals by the accelerometer. Then, the number of minutes spent in sedentary (METs ≤ 1), moderate to intense (METs ≤ 3) and intense (METs ≤ 6) physical activities was calculated. In order to control the difference between the subjects in the evaluation period, the percentage of time spent in sedentary activity, moderate to vigorous physical activity and vigorous physical activity was calculated and for further analysis of these percentages was used. Also, the average continuous periods of 5 and 10 minutes of moderate to intense physical activity (MVPA-5 min and 10 min) were calculated.

### Evaluation of the severity of ASD

In order to assess the severity of ASD, the ASD Treatment Evaluation Checklist was used, which was completed by parents, guardians, or their teachers [33]. This tool is on a Likert scale and includes four axes: verbal, social, cognitive and sensory, health and behavior. In addition to the child's individual scores in each of the subscales, the total scores obtained from the child's condition in all four subscales were also calculated. Based on the obtained scores, a lower score indicates a lower intensity of the disorder characteristics in the desired field.

### Statistical analysis

SPSS-Ver.22 software was used for statistical analysis. In order to evaluate intra-individual and inter-individual changes in the amount of activity between different days, intra-period correlation with 95% confidence interval was calculated. Descriptive statistics were reported in the form of central indices, dispersion and tables, and their frequency was calculated to obtain the percentage of participants who had the minimum recommended physical activity. Kolmogorov-Smirnov test was used to check the normality of data

distribution. Independent 2 sample t-test was used to compare the PDA levels of boys and girls at a significance level of  $\alpha=0.05$ . Also, Spearman's correlation test was used to check the relationship between research variables. Finally, the variables that were significant in the correlation tests were entered into a regression analysis for the amount of physical activity.

## Results

In the present study, 70 participants were evaluated, the results of 8 of them were excluded from the study due to being incomplete and invalid, and finally, statistical analyzes were performed on the results of the remaining 62 people. Therefore, the final participants of the present study consisted of 45 boys and 17 girls, whose average age was  $9.68 \pm 2.09$  years and  $9.75 \pm 2.18$  years, respectively. The obtained results showed that there is a strong correlation ( $r=0.92$ ,  $CI=0.86-0.94$ ) between the measurement days. The results showed that the PDA level of girls was significantly lower in all PDA variables and the level of sedentary activities was significantly higher than of boys (Table 1).

Variables	Female	Male	P
Count Per Minute (CPM)	225.4 ± 479.6	261.3 ± 689.7	0.005**
Steps Per Minute (SPM)	2.91 ± 9.366	4.7 ± 14.1	>0.001**
Moderate to Vigorous Physical Activity (MVPA)	84.4 ± 125.3	105.9 ± 201.6	0.01**
Vigorous Physical Activity (VPA)	16.7 ± 8.6	8.9 ± 17.2	0.005**
Sedentary Activity (SA)	110.7 ± 622.4	110.3 ± 546.8	0.001**
MVPA-5 min	5.9 ± 6.8	10.7 ± 16.3	>0.001**
MVPA-10 min	0.56 ± 1.21	2.1 ± 3.8	>0.001**

\* At significance level of  $\alpha =0.05$  \*\* At significance level of  $\alpha =0.001$

**Table 1.** Comparison of daily physical activity (in minutes) of autistic boys and girls based on different variables.

Based on the results of the present study, it was found that 87.5% (n=42) of boys and 82.5% (n=14) of girls do not participate in the recommended minimum PDA. The findings of the study showed that there is a significant and negative relationship between the age of the

participants and all the variables of their physical activity except the number of counts and the number of steps per minute ( $P<0.01$ ). Also, age had a positive and significant relationship with the percentage of sedentary physical activity ( $P<0.05$ ) (Table 2).

Variables		r	P
Age	CPM	-0.23	0.11
	SPM	-0.22	0.1
	MVPA	-0.64	>0.001**
	VPA	-0.39	0.001**
	SA	0.28	0.039
	MVPA-5 min	-0.58	>0.001**
	MVPA-10 min	-0.52	>0.001**

\* At significance level of  $\alpha=0.05$  \*\* At significance level of  $\alpha=0.001$

**Table 2.** Significance level and correlation coefficient between variables related to physical activities and age variable.

The results of the present study showed that none of the PDA variables had a significant relationship with the level of communication verbal skill, social skill and health as well as the behavior of autistic children ( $P>0.05$ ) (Table 3). Also, based on the results, cognitive and sensory awareness with the variables of Counting Per Minute (CPM), number of Steps Per Minute (SPM),

percentage of Vigorous Physical Activity (VPA), periods of Moderate to Vigorous Physical Activity (10 min-MVPA) ( $P<0.05$ ) and 5 min-MVPA ( $P<0.01$ ), there is a significant and negative relationship. While, cognitive and sensory awareness has a significant and positive relationship with the percentage of Sedentary Activities (SA) ( $P<0.05$ ) (Table 3). In addition, the overall severity of the participants' disorder had as significant and negative correlation only with the percentage of their vigorous physical activity ( $P<0.05$ ).

Variables	Verbal-communication skill		Social skill		Cognitive-sensory awareness		Health and behavior		The overall severity of the disorder	
	r	P	r	P	r	P	r	P	r	P
CPM	-0.15	0.25	-0.22	0.09	-0.32	0.014*	0.001	0.99	-0.23	0.13
SPM	-0.09	0.59	-0.16	0.28	-0.29	0.02*	0.75	-0.04	-0.19	0.17
MVPA	-0.08	0.58	-0.13	0.35	-0.25	0.08	0.9	0.03	-0.12	0.38
VPA	-0.2	0.17	-0.19	0.18	-0.32	0.013*	0.58	-0.09	-0.27	0.04*
SA	0.11	0.51	0.05	0.73	-0.31	0.017*	0.56	0.09	0.1	0.49
MVPA-5 min	-0.08	0.59	-0.15	0.29	-0.38	0.006**	0.72	0.06	-0.14	0.27
MVPA-10 min	-0.13	0.41	-0.17	0.21	-0.32	0.016**	0.53	0.09	-0.16	0.28

\* At significance level of  $\alpha=0.05$  \*\* At significance level of  $\alpha=0.001$

**Table 3.** Significance level and correlation coefficient between variables related to physical activities and severity of autism spectrum disorder.

Based on the results, the age variable is significant in vigorous models and is their predictor. Gender in all models, except for the regression physical activity related to MVPA, SA and 5 min-MVPA and 10 min-MVPA and cognitive and sensory awareness only in the

model of VPA and cognitive awareness and sensation is significant only in the model of VPA and is their predictor (Table 4).

Model	Predictor variable	R <sup>2</sup>	R <sup>2</sup> - adj (adj)	Beta	t	p
CPM	Gender	0.13	0.13	-0.36	-2.98	0.006**
SPM	Gender	0.12	0.14	-0.37	-3.18	0.003**
MVPA	Age	0.47	0.51	-0.65	-7.05	<0.001**
	Gender			-0.32	-3.38	0.004**
VPA	Cognitive-sensory awareness	0.11	0.1	-0.35	-2.72	0.015*
SA	Age	0.23	0.21	0.44	3.72	<0.001**
	Gender			0.26	2.24	0.035**
MVPA-5 min	Age	0.36	0.32	-0.61	-4.95	<0.001**
	Gender			-0.37	-3.34	<0.001**
MVPA-10 min	Age	0.27	0.24	-0.45	-3.89	0.001**
	Gender			-0.3	-2.91	0.008**

\* At significance level of  $\alpha=0.05$  \*\* At significance level of  $\alpha=0.001$

**Table 4.** Results of regression analysis to predict physical activity variables.

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## Discussion

In Iran, very limited studies have been conducted on the status and pattern of PDA in children with ASD [33]. Therefore, the results of the present study can be useful for further studies in the future. According to the findings of the present study, children with high functioning autism face inactivity and a sedentary lifestyle. According to the findings of the present study, girls are significantly more sedentary than boys. The variables of age, gender, and the level of cognitive and sensory awareness of the participants were recognized as relevant factors and predictors of the physical activity of these children. Also, the results showed that the amount of intense physical activity of these children has a significant inverse relationship with the overall severity score of their disorder. Therefore, the research hypotheses related to the lack of physical activity of these children and the decrease in their physical activity level with increasing age, as well as the inverse relationship between their physical activity level and the severity of impairment in cognitive and sensory awareness, were confirmed. In addition, the hypothesis of the relationship between the level of physical activity and the severity of the disorder in other areas was not confirmed. All the above-mentioned results were consistent with the results of the study by Ghaheri et al. [34]. In addition, the results of the present study with the study of Pan et al. was consistent, as in that study it was shown that children with ASD do not have the minimum PDA to prevent disease caused by inactivity [35].

According to the social model of disability, a high percentage of participants are inactivity and also the low participation of these children in intense physical activities and continuous courses compared to children with normal development [38], shows the failure of the society in providing of proper opportunities and facilities for autistic children. In addition, the social and behavioral disabilities as well as the defects and movement problems of children with ASD can be limiting factors for the participation of children with ASD in physical activities [36].

Girls participating in the present study had significantly less physical activity than boys. In addition, the gender variable was recognized as an important and determining factor in the amount of physical activity of these children, and these results are not consistent with the results of the study by MacDonald does not match. The results of that study showed that there is no significant difference between the PDA levels of girls and boys with ASD. The greater inactivity of girls in the present study could be due to fewer opportunities to participate in PDA compared to boys, which is likely to be more pronounced in developing countries.

Based on the results of the present study, it was found that a sharp decrease in physical activity and an increase in sedentary activity in children with ASD along with increasing age and the importance of age as an important predictor of PDA in this population [37]. This could be due to their increasing involvement in sedentary entertainment such as watching TV, playing computer games, and reducing their presence in game and active environments. In addition, at older ages, structured, complex, and competitive physical programs and activities require more complex physical skills. While these children will not be able to participate in games and activities that require learning strategic and high level skills due to the disorder and limitations caused.

The findings of the present study showed that the severity of the participants' disorder in the field of cognitive and sensory awareness has an inverse and significant relationship with their PDA level and is also a determining factor in their vigorous PDA level. Also, there is a significant inverse relationship between the vigorous PDA level and the overall severity score of these children. The results of the present study showed that PDA and physical exercise help to improve people's cognitive performance. In addition, PDA leads to the improvement of cognitive skills such as planning, organization, problem solving, concentration, decision making in children [38]. The results of previous similar studies show that with the increase in children's PDA level, their performance in each of the aforementioned skills increases significantly [39].

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## Conclusion

Based on the results of the present study, it can be concluded that most of the participants of the present study did not have the minimum PDA level recommended to prevent the negative consequences of inactivity. Based on the findings of the present study, it can be said that children with ASD tend to become sedentary as they get older. In addition, girls with ASD had significantly less PDA than boys. The variables of age, gender, and the level of cognitive and sensory awareness of the participants were the most important factors predicting the physical activity of children with ASD. Also, the results showed that the level of vigorous PDA of these children is significantly inversely related to the overall severity score of their disorder. According to the results of this study, it is suggested to design effective interventions for PDA, especially vigorous PDA periods, and to provide suitable opportunities for children with ASD to participate in PDA, especially for girls, to prevent inactivity and increase their PDA at older ages. In addition, it is recommended to use physical activity programs, especially with high intensity, to reduce the severity of the disorder in children with ASD.

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